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(54) **LASER DIODE PRIMER AND CANNON IGNITING PROPELLING CHARGES WITH ELECTRICAL SIGNAL USING THE SAME**

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CPC ***F41A 19/58*** (2013.01); ***F41A 3/10*** (2013.01); ***F41A 19/57*** (2013.01); ***F41F 1/00*** (2013.01)

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USPC 42/14; 89/27.11, 28.05, 28.1, 28.2
See application file for complete search history.

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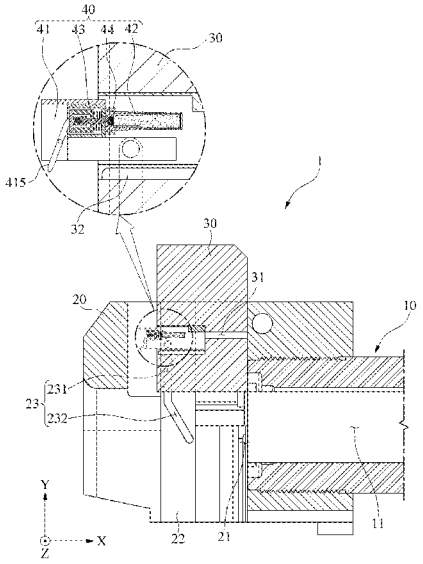
(57) **ABSTRACT**

A cannon includes: a barrel; a breech ring connected to the rear of the barrel; a breechblock connected to be movable with respect to the breech ring between a closed position and an open position; an ignition device mounted to be partially movable with respect to the breechblock and configured to ignite a propelling charge; and a controller configured to transfer an electrical firing signal, wherein the ignition device includes: a firing assembly moving forward and backward as the breechblock moves; a laser diode primer connected to the front of the firing assembly and configured to receive the electrical firing signal to ignite the propelling charge; and a firing pin connected to be movable forward and backward with respect to the firing assembly and configured to transfer the electrical firing signal to the laser diode primer while in contact with a rear end of the laser diode primer.

8 Claims, 9 Drawing Sheets



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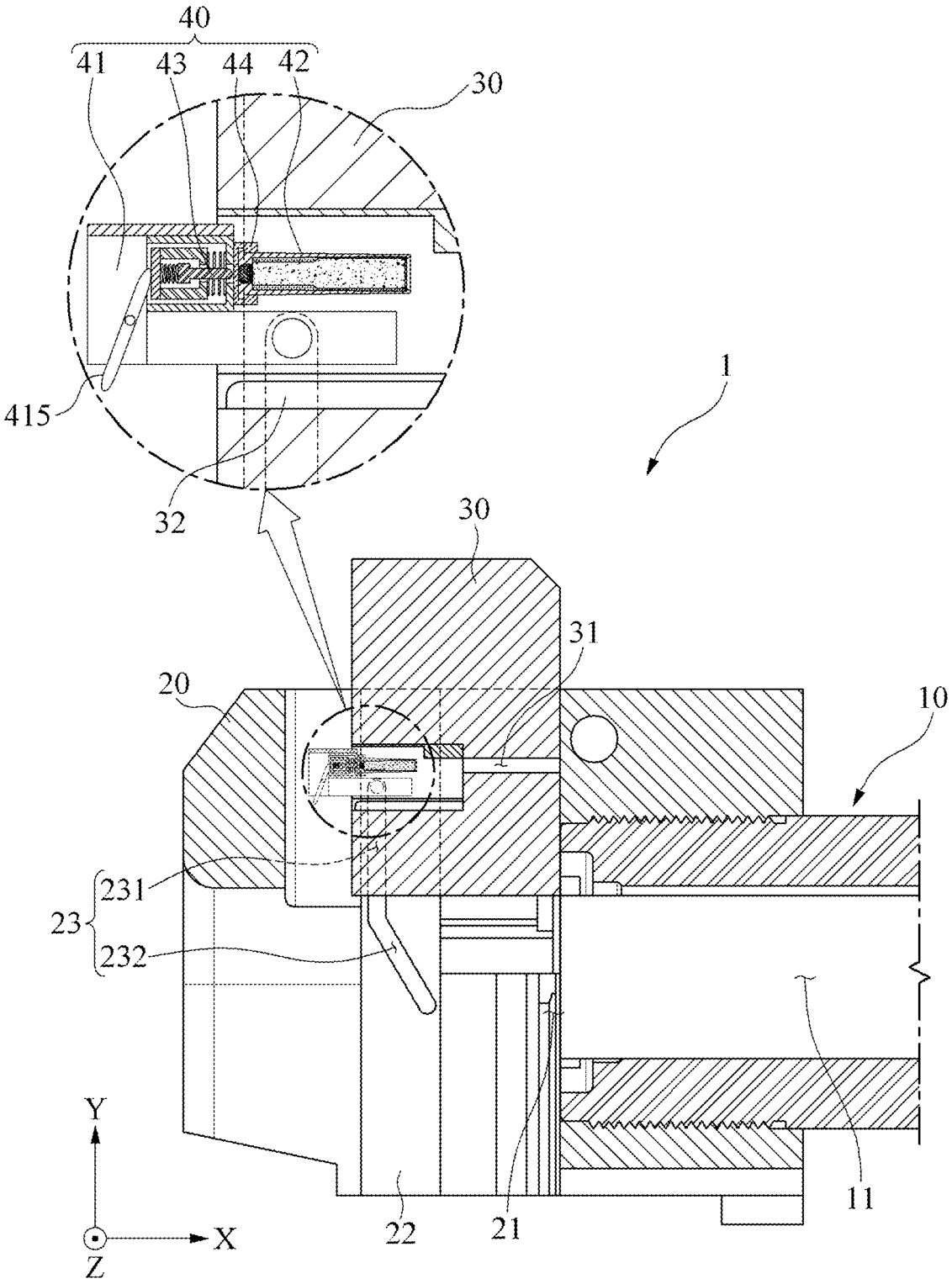

FIG. 1

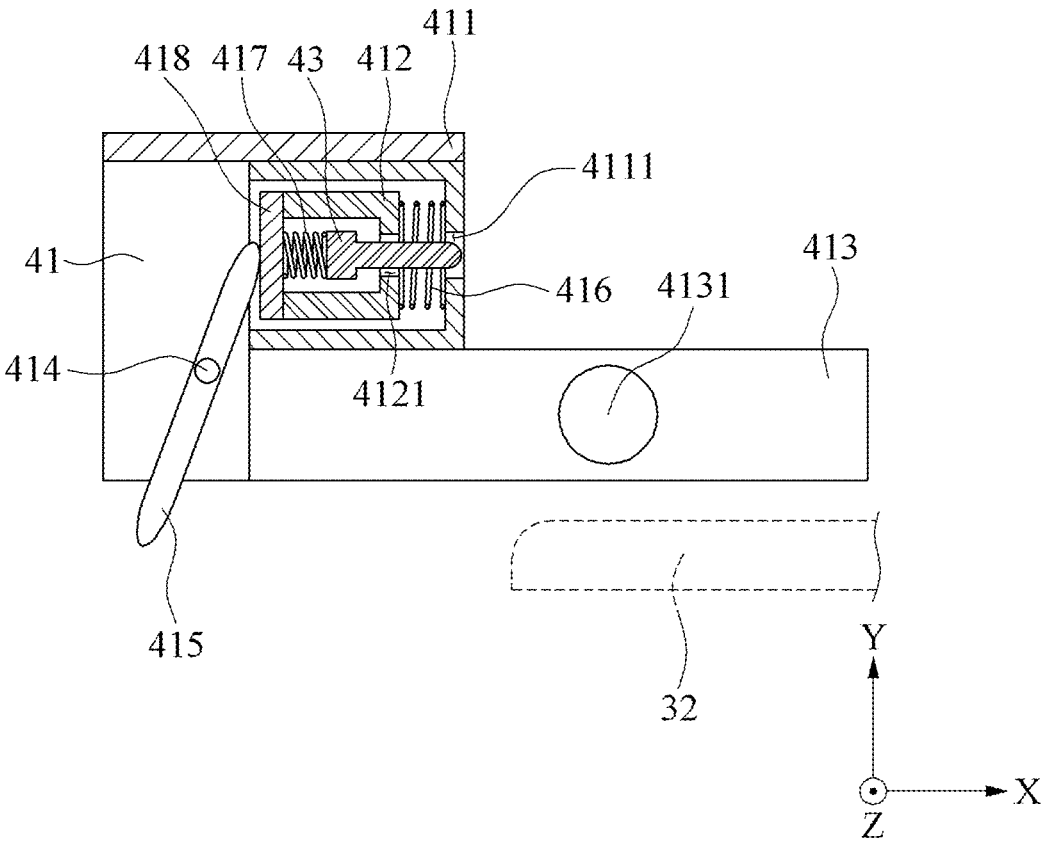

FIG. 2A

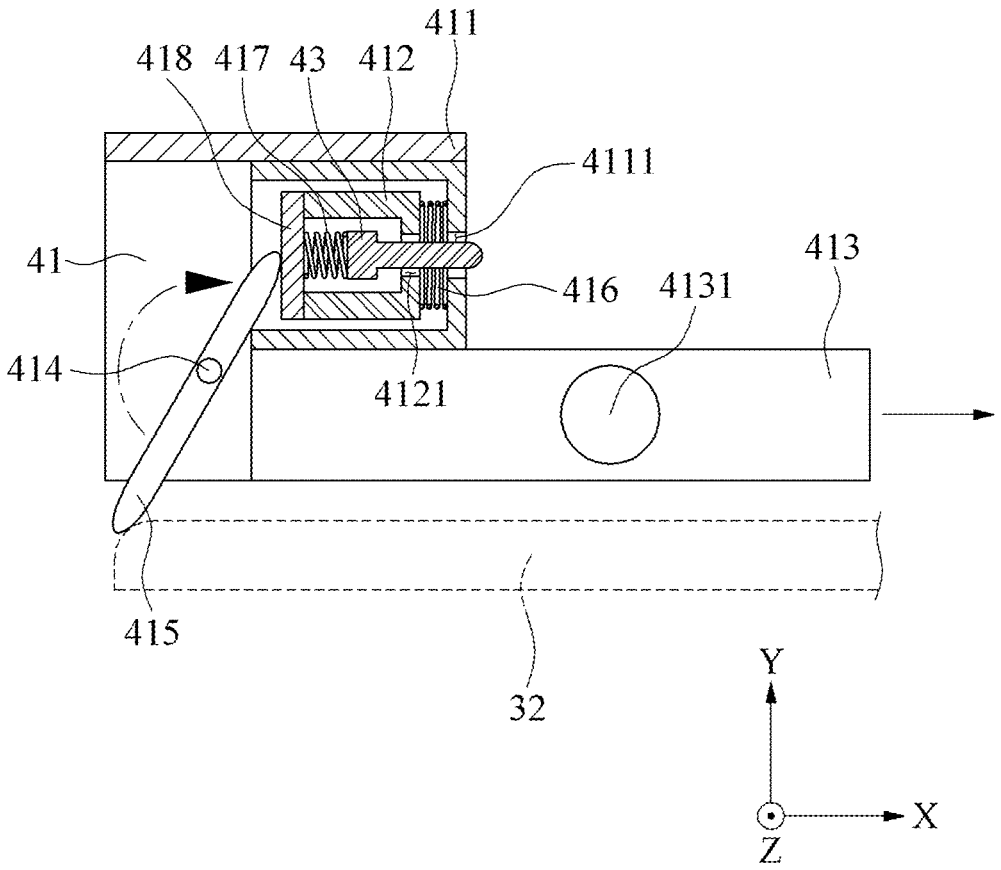

FIG. 2B

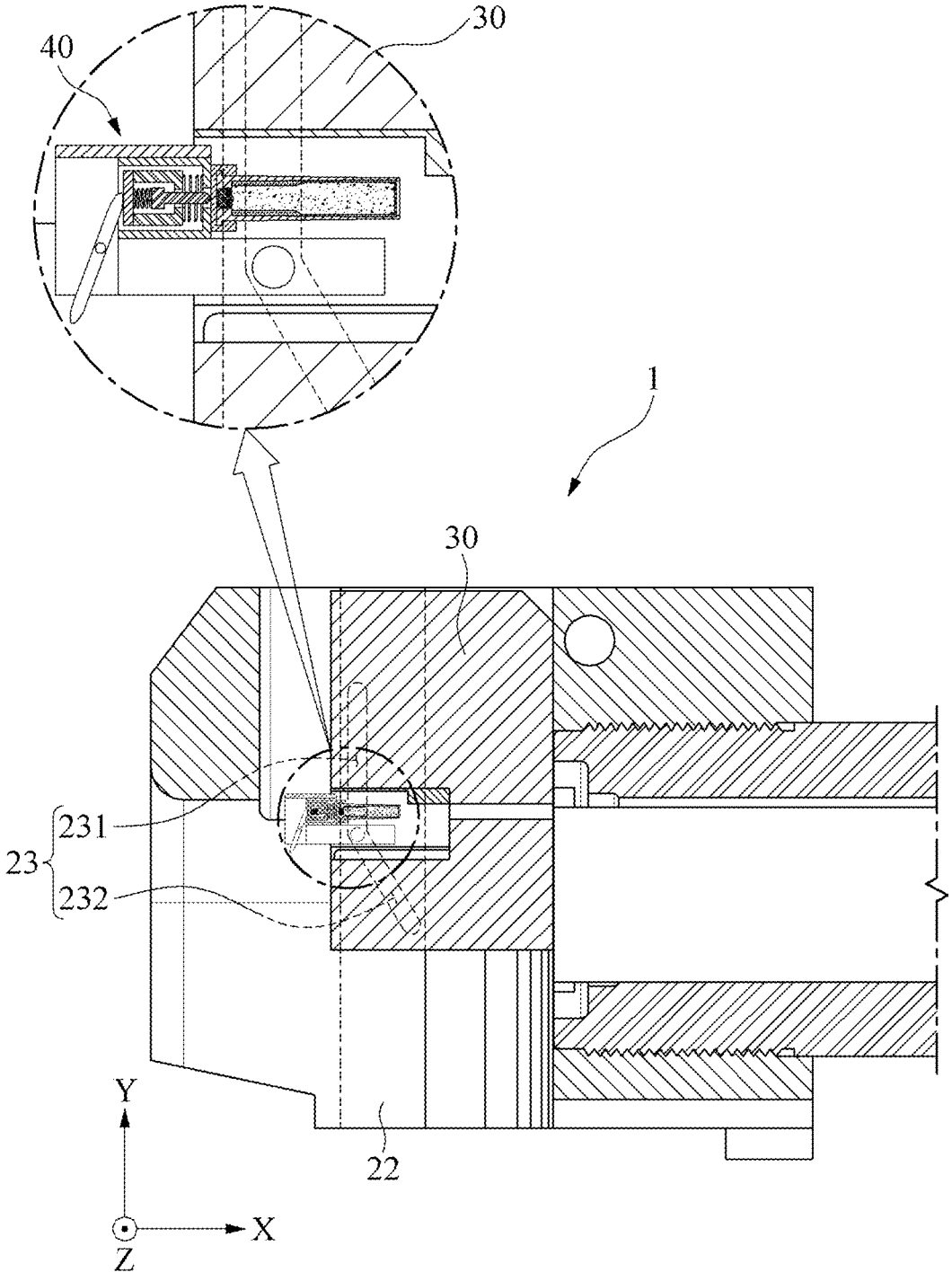

FIG. 3A

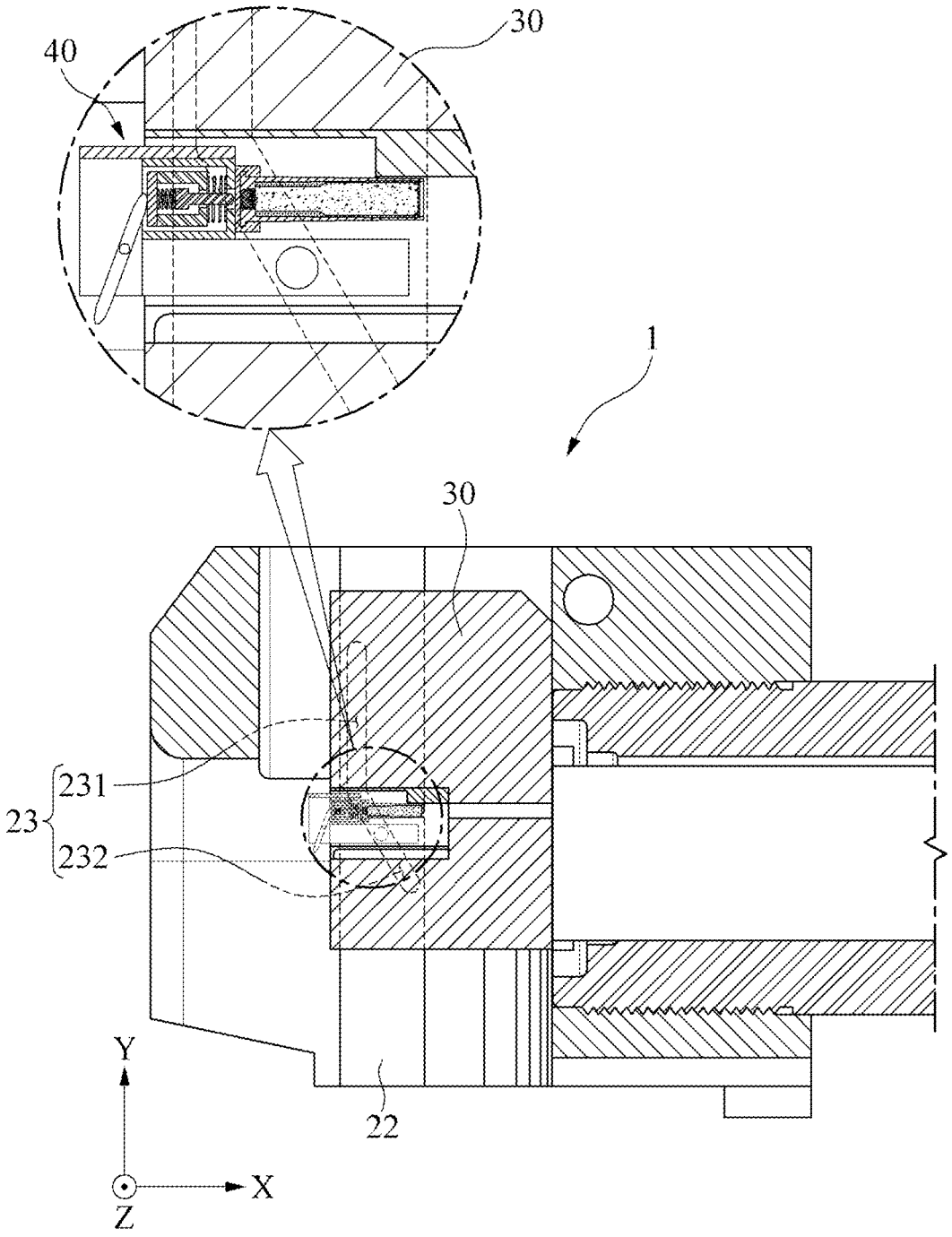

FIG. 3B

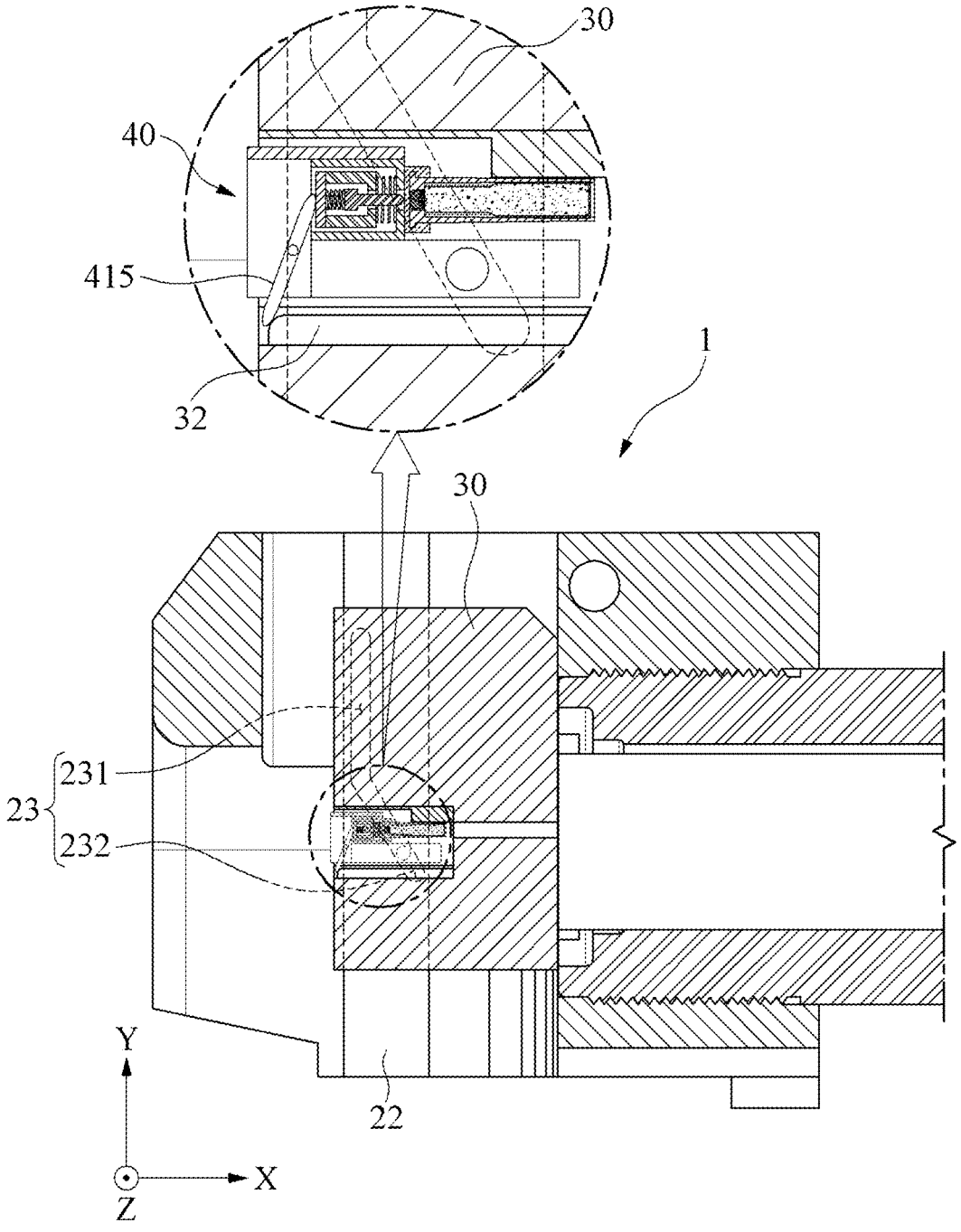

FIG. 3C

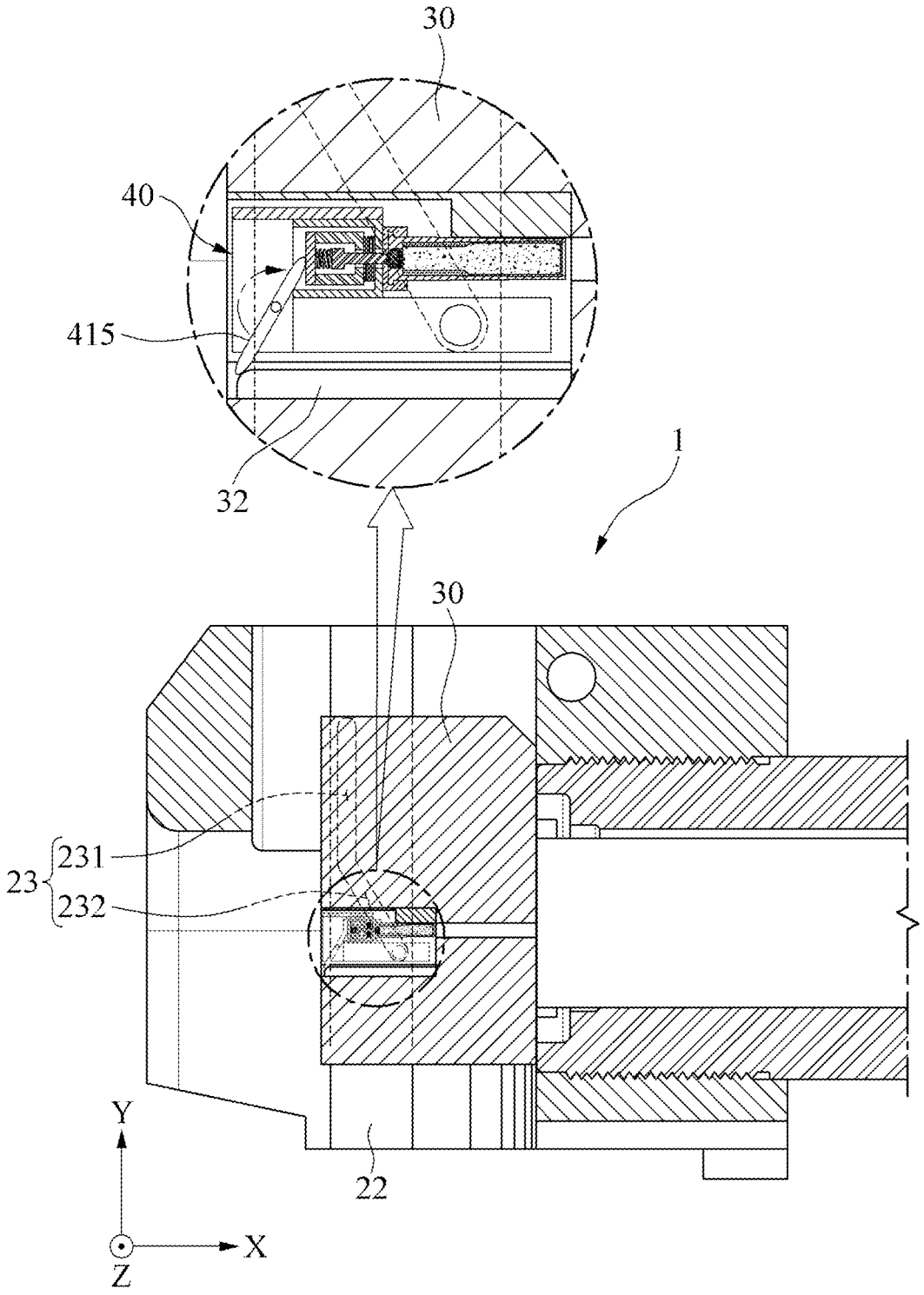

FIG. 3D

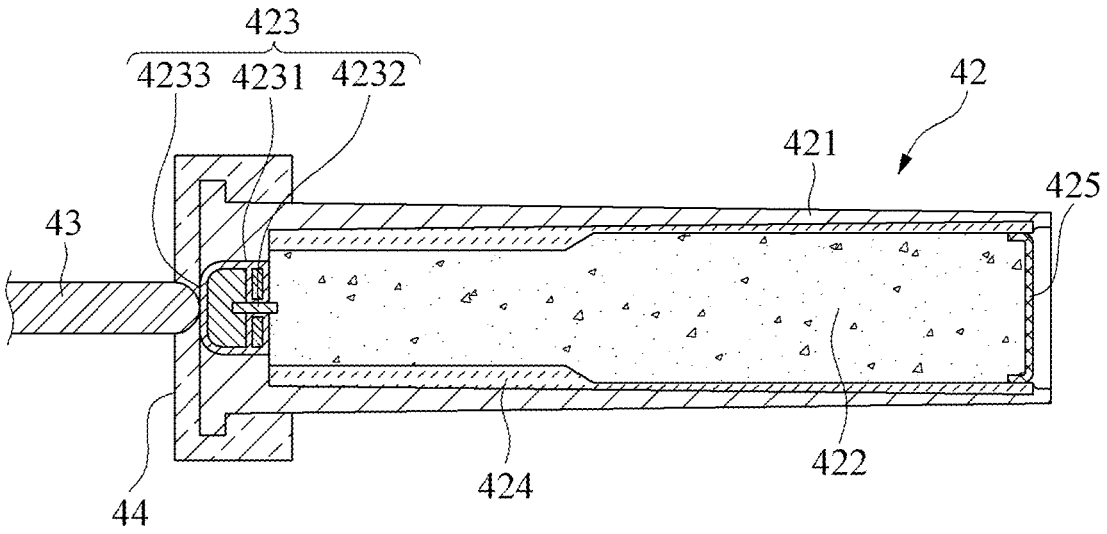

FIG. 4A

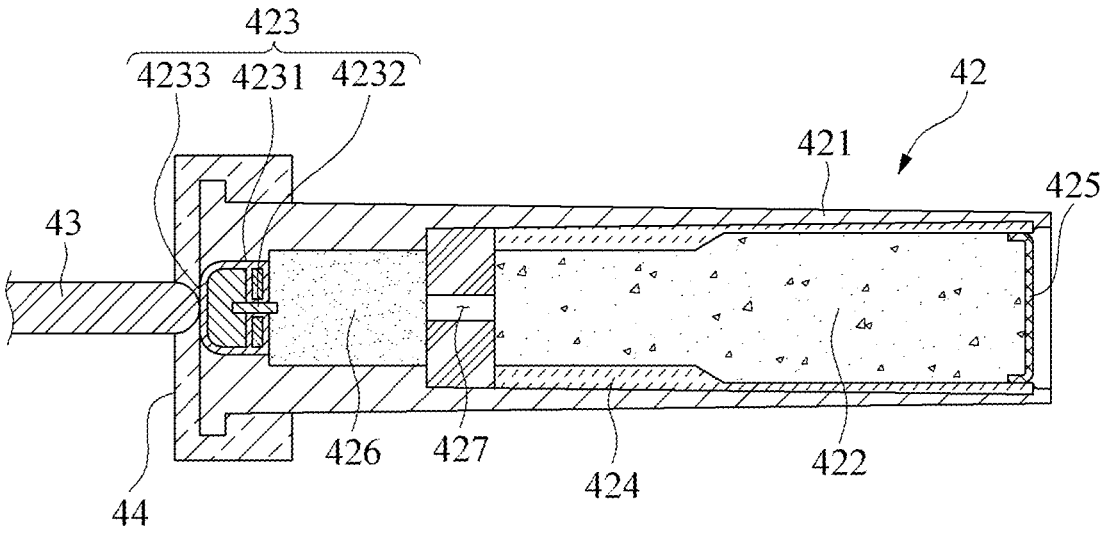

FIG. 4B

LASER DIODE PRIMER AND CANNON IGNITING PROPELLING CHARGES WITH ELECTRICAL SIGNAL USING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority under 35 USC § 119 (a) to Korean Patent Application No. 10-2024-0083470 filed on Jun. 26, 2024, in the Korean Intellectual Property Office, the disclosure of which is incorporated by reference herein in its entirety.

BACKGROUND

1. Field

The following description relates to a laser diode primer and a cannon igniting a propelling charge with an electrical firing signal using the laser diode primer.

2. Description of Related Art

In general, a cannon ignites a propelling charge and fires a shell using the pressure of the ignited propelling charge. A typical method of percussing a primer to ignite the propelling charge may require extraction and resupply of the primer, which may consume human labor and costs and may cause the propelling charge to misfire or fire at an unintended time. A laser ignition method, which may replace a typical firing method, has been proposed to automate the operation of the cannon and reduce the costs. However, it still has a disadvantage in that an ignition delay time of the propelling charge increases compared to the typical firing method.

The above description is information the inventor(s) acquired in the course of conceiving the present disclosure, or already possessed at the time, and is not necessarily art publicly known before the present application was filed.

SUMMARY

An object of the present disclosure is to provide a cannon that ignites a propelling charge using a laser diode primer.

An object of the present disclosure is to provide a cannon with a reduced ignition delay time compared to a typical laser ignition method.

According to an embodiment, there is provided a cannon including: a barrel having a chamber formed therein in which a shell and a propelling charge are mounted; a breech ring connected to the rear of the barrel, and having a shell inlet communicating with the chamber; a breechblock connected to the breech ring to be movable upward and downward with respect to the breech ring between a closed position that closes the shell inlet and an open position that opens the shell inlet, and having a primer flame hole communicating with the chamber at the closed position; an ignition device mounted to be partially movable with respect to the breechblock and configured to ignite the propelling charge mounted in the chamber through the primer flame hole; and a controller configured to transfer an electrical firing signal to the ignition device. The ignition device may include: a firing assembly configured to move forward and backward as the breechblock moves; a laser diode primer including a case and gunpowder disposed inside the case, connected to the front of the firing assembly and contacting the rear of the primer flame hole at the closed position, and configured to receive the electrical firing signal to ignite the propelling charge through the primer flame hole; and a firing pin connected to the firing assembly to be movable forward and backward with respect to the firing assembly and configured to transfer the electrical firing signal to the laser diode primer while in contact with a rear end of the laser diode primer.

The firing assembly may include: a support member; a first housing disposed on the support member and including a first opening that is open forward; a second housing disposed within the first housing, movable forward and backward inside the first housing, and including a second opening that is open forward; and a lever member configured to press the second housing forward through a rotation. The firing pin may be installed in the second housing such that a front end thereof passes through the first opening.

The firing assembly may further include a first spring installed in the first housing and configured to restore a position of the second housing.

The firing pin may be positioned inside the first housing when no external force is applied, and the front end may protrude to the front of the first housing when the second housing is pressed forward by the lever member.

The firing pin may come into contact with the rear end of the laser diode primer by a rotation of the lever member when the breechblock is at the closed position.

The firing assembly may further include a second spring installed in the second housing and connected to a rear end of the firing pin. The second spring may be compressed when the second housing is pressed forward, and apply a restoring force to the firing pin such that at least a portion of the firing pin is positioned on the first opening when no external force is applied to the second housing.

The breech ring may further include a cam plate having a guiding groove formed therein, the support member may further include a follower movably connected to the guiding groove, and the breechblock may further include a pushrod selectively contacting the lever member. While the breechblock is moving from the open position to the closed position, the firing assembly may move forward by a movement of the follower, and the lever member may rotate by contacting the pushrod by the forward movement of the firing assembly.

The guiding groove may include: a first guiding groove portion extending in a height direction; and a second guiding groove portion connected to a bottom of the first guiding groove portion and extending downward while inclined forward. The ignition device may move forward and backward with respect to the breechblock as the follower moves along the second guiding groove portion.

The cannon according to embodiments described herein may use an ignition device, which replaces a typical percussive trigger, to fire with an electrical firing signal.

The cannon according to embodiments described herein may have a reduced ignition delay time and ensure high reliability in the operation of the cannon.

The cannon according to embodiments described herein may have an electrical connection as a firing assembly moves backward or forward by a breechblock ascending or descending, thereby implementing the automated operation of the cannon.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features of certain embodiments of the present disclosure will be more apparent from the

following detailed description, taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a schematic view of a cannon illustrating a state in which a breechblock is at an open position according to an embodiment;

FIGS. **2**A and **2**B are schematic views of a cannon illustrating a process in which a second housing is pressed forward as a lever member of an ignition device comes into contact with a pushrod according to an embodiment;

FIGS. **3**A through **3**D are schematic views of a cannon illustrating a process in which an ignition device moves forward with respect to a breechblock while the breechblock is descending according to an embodiment; and

FIGS. **4**A and **4**B are schematic views of a cannon illustrating a laser diode primer that ignites gunpowder with a laser diode according to an embodiment.

DETAILED DESCRIPTION

Hereinafter, embodiments will be described in detail with reference to the accompanying drawings. However, various changes may be made to the embodiments, and the scope of claims of the present disclosure is not limited or circumscribed by these embodiments. It should be understood that any modifications, equivalents, or substitutions to the embodiments are included in the scope of the claims.

The terminology used in the embodiments is for illustrative purposes only and should not be construed as limiting. As used herein, the singular forms are intended to include the plural forms as well, unless the context clearly indicates otherwise. It should be further understood that the terms "comprise," "comprising," "include," and/or "including," when used in this disclosure, specify the presence of stated features, integers, steps, operations, elements, components, or a combination thereof, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Unless otherwise defined herein, all terms used herein including technical or scientific terms have the same meanings as those generally understood by one of ordinary skill in the art. Terms defined in generally used dictionaries should be construed to have meanings matching with contextual meanings in the related art and are not to be construed as an ideal or excessively formal meaning unless otherwise defined herein.

However, when describing the embodiments with reference to the accompanying drawings, identical components are given the same reference numerals regardless of the designations in the drawings, and detailed descriptions of well-known functions or configurations will be omitted for the clarity of the gist of the present disclosure.

Although terms of "first," "second," A, B, (a), and (b) are used to explain various components, the components are not limited to the terms. These terms should be used only to distinguish one component from another component, and do not define the nature, sequence, or order of the components. It is to be understood that, when a component is referred to as being "connected to" another component, the component can be directly connected or coupled to the other component, or intervening components may be present therebetween.

Also, components included in an embodiment, and components having common features, are described using the same designations in other embodiments. Unless otherwise indicated, the description of one embodiment applies to the other embodiments, and a detailed description thereof is omitted when it is deemed to be redundant.

FIG. **1** is a schematic view of a cannon **1** illustrating a state in which a breechblock is at an open position according to an embodiment.

Referring to FIG. **1**, **1** according to an embodiment, the cannon may fire a shell. For example, a shell (not shown) and a propelling charge (not shown) for firing the shell may be loaded. The cannon **1** may ignite the propelling charge through an ignition device **40** and fire the shell by the pressure generated from the ignition of the propelling charge along a set trajectory. The cannon **1** may include a barrel **10**, a breech ring **20**, a breechblock **30**, the ignition device **40**, and a controller (not shown).

In an embodiment, the barrel **10** may have a chamber **11** formed therein in which the shell and the propelling charge are mounted. The barrel **10** may be formed to extend in a longitudinal direction of the chamber **11**. For example, the barrel **10** may be provided in the form of a cylinder extending in the longitudinal direction (e.g., a +X direction) of the chamber **11**. The chamber **11** may be open at both ends of the barrel **10**. For example, at one end of the barrel **10** facing forward (e.g., the +X direction), an opening may be formed through which the shell is fired along the chamber **11**. At the other end of the barrel **10** facing backward (e.g., a −X direction), the breech ring **20** may be connected. The shell may be loaded into the chamber **11** through the other open end of the barrel **10**. Hereinafter, unless otherwise stated, the term "forward" or "front" may be construed as the +X direction, and the term "backward" or "rear" may be construed as the −X direction, for ease of explanation. In addition, the term "move forward" may be construed that a certain component moves in the +X direction, and the term "move backward" may be construed that a certain component moves in the −X direction.

In an embodiment, the breech ring **20** may be connected to the rear of the barrel **10**. The breech ring **20** may have a shell inlet **21** formed therein to communicate with the chamber **11** into which the shell is loaded. For example, in the process of using the cannon **1**, the shell and the propelling charge may be sequentially loaded into the chamber **11** through the shell inlet **21** formed in the breech ring **20**. In an embodiment, the breech ring **20** may include a cam plate **22** having a guiding groove **23** formed therein. As will be described below, the guiding groove **23** may be used to move a firing assembly **41**.

In an embodiment, the breechblock **30** may open or close the shell inlet **21**. The breechblock **30** may be connected to be movable upward or downward relative to the breech ring **20**. For example, the breechblock **30** may move between a closed position (refer to FIG. **3**D) that closes the shell inlet **21** and an open position (refer to FIG. **1**) that opens the shell inlet **21**, with respect to the breech ring **20**. For example, the breechblock **30** may ascend relative to the breech ring **20** to open the shell inlet **21** at the open position, and descend relative to the breech ring **20** to close the shell inlet **21** at the closed position. When the breechblock **30** is at the closed position, the breechblock **30** may close the other end of the chamber **11** facing the shell inlet **21** to prevent the pressure generated by the combustion of the propelling charge from leaking out to the rear of the barrel **10**. When the breechblock **30** is at the open position, the shell and the propelling charge may be loaded into the chamber **11** through the shell inlet **21**. The breechblock **30** may have a pushrod **32** formed therein that selectively comes into contact with a lever member **415** to press the lever member **415**.

In an embodiment, the breechblock **30** may have a primer flame hole **31** formed therein. The primer flame hole **31** may be formed to communicate with the chamber **11** when the

breechblock **30** is at the closed position. As will be described below, the rear of the primer flame hole **31** may contact the ignition device **40**, and the primer flame hole **31** may transfer a flame generated by the ignition device **40** to the propelling charge mounted in the chamber **11**. For example, the primer flame hole **31** may be provided in the form of a hollow cylinder to transfer the flame.

In an embodiment, the ignition device **40** may ignite the propelling charge mounted in the chamber **11**. The ignition device **40** may be mounted to be partially movable relative to the breechblock **30**. For example, the ignition device **40** may be configured to move backward when the breechblock **30** is at the open position and move forward when the breechblock **30** is at the closed position. The ignition device **40** may come into contact with the rear of the primer flame hole **31** by moving forward when the breechblock **30** is at the closed position. In this case, the ignition device **40** may receive an electrical firing signal to ignite the propelling charge loaded in the chamber **11** through the primer flame hole **31**. The ignition device **40** may include the firing assembly **41**, a laser diode primer **42**, a firing pin **43**, and a primer holder **44**.

In an embodiment, the firing assembly **41** may move forward (e.g., in the +X direction) or backward (e.g., in the −X direction) as the breechblock **30** moves. The breechblock **30** may have a space that receives therein the firing assembly **41** which may move forward or backward together with the laser diode primer **42** and the firing pin **43** in the space as the breechblock **30** moves.

In an embodiment, the laser diode primer **42** may ignite the propelling charge. The laser diode primer **42** may be connected to the front of the firing assembly **41**. For example, the laser diode primer **42** may be connected to the front of the firing assembly **41** via the primer holder **44**. The laser diode primer **42** may not be in direct contact with the firing assembly **41** but may be electrically connected to the firing assembly **41** by a forward movement of the firing pin **43**. For example, when the breechblock **30** is at the closed position, the front of the laser diode primer **42** may come into contact with the rear of the primer flame hole **31**, and the rear of the laser diode primer **42** may come into contact with the firing pin **43** (refer to FIG. **3**D). While electrically connected, the laser diode primer **42** may receive the electrical firing signal to ignite the propelling charge.

In an embodiment, the firing pin **43** may transfer the electrical firing signal received from the controller to the laser diode primer **42**. The firing pin **43** may be connected to be movable forward and backward (e.g., in the X-axis direction) with respect to the firing assembly **41**. For example, while the breechblock **30** is moving from the open position to the closed position, the firing pin **43** may protrude to contact the rear end of the laser diode primer **42**, and may transfer the electrical firing signal to the laser diode primer **42** while in contact.

FIGS. **2**A and **2**B are schematic views of the cannon **1** illustrating a process in which a second housing **412** is pressed forward as the lever member **415** comes into contact with the pushrod **32** and rotates, according to an embodiment.

The operations of the firing assembly **41** and the firing pin **43** will be described below with reference to FIGS. **1**, and **2**A and **2**B. The firing assembly **41** may include a support member **413**, a first housing **411**, the second housing **412**, the lever member **415**, a first spring **416**, and a second spring **417**.

In an embodiment, the support member **413** may be connected to support the first housing **411** and the second housing **412**. The support member **413** may be connected to be movable forward and backward within the breechblock **30**. The support member **413** may include a follower **4131** for moving forward and backward.

In an embodiment, the follower **4131** may be movably connected to the guiding groove **23** formed on the cam plate **22** of the breechblock **30**. For example, the follower **4131** may move the support member **413** connected to the follower **4131** forward or backward while moving along a path of the guiding groove **23**. As will be described below, even when the follower **4131** moves, the support member **413** may not move forward or backward depending on the shape of the guiding groove **23**. Although the guiding groove **23** is shown as a single guiding groove in FIG. **1**, it should be understood as an example only for ease of explanation, and the guiding groove **23** may be provided as a pair of guiding grooves connected to both sides of the follower **4131**.

In an embodiment, the first housing **411** may be disposed on the support member **413**. The first housing **411** may move forward or backward along with the support member **413** while the support member **413** is moving forward or backward. For example, the first housing **411** may include a first opening **4111** that is open forward. That is, the first opening **4111** may be formed in a direction facing the laser diode primer **42** disposed at the front of the first housing **411**. For electrical insulation between the firing pin **43** present inside the first housing **411** and the breechblock **30** outside the first housing **411**, the first housing **411** may be formed of an insulating material.

In an embodiment, the second housing **412** may be disposed inside the first housing **411**. The second housing **412** may be disposed to be movable forward and backward within the first housing **411**. For example, the second housing **412** may be configured to slide forward and backward within the first housing **411**. For example, the second housing **412** may include a second opening **4121** that opens forward. Similar to the first opening **4111**, the second opening **4121** may be formed in a direction facing the laser diode primer **42**. The second opening **4121** may be formed to face the first opening **4111** such that the firing pin **43** may pass through the first opening **4111** and the second opening **4121** simultaneously. For electrical insulation between the firing pin **43** present inside the second housing **412** and the breechblock **30** outside the second housing **412**, the second housing **412** may be formed of an insulating material.

In an embodiment, the lever member **415** may be rotatably connected to the support member **413**. For example, a rotation axis **414** of the lever member **415** may be fixed to the support member **413**, and an axial direction of the rotation axis **414** may be perpendicular to a movement direction of the support member **413** relative to the breechblock **30**. For example, the rotation axis **414** may be parallel to a Z-axis direction.

The lever member **415** may be configured to press the second housing **412** forward through a rotation. Although one end of the lever member **415** is shown as being in contact with a rear end of the second housing **412** in FIG. **2**A, there may be a gap between the one end of the lever member **415** and the rear end of the second housing **412**. In this case, the lever member **415** may rotate to contact the rear end of the second housing **412**, and may thereafter press the second housing **412**. In this case, the other end of the lever member **415** that does not press the second housing **412** may be configured to contact the pushrod **32** by a forward movement of the support member **413**. As the support member **413** continues moving forward after the lever member **415** contacts the pushrod **32**, the lever mem-

ber **415** may rotate, and the one end disposed opposite the other end in contact with the pushrod **32** may press the second housing **412**. It is apparent to a person of ordinary skill in the art that the degree to which the lever member **415** presses the second housing **412** may be adjusted by defining a suitable length of the lever member **415**.

In an embodiment, the first spring **416** may be installed in the first housing **411**. The first spring **416** may be connected to apply a restoring force to the second housing **412**. For example, one end of the first spring **416** may be connected to the first housing **411**, and the other end of the first spring **416** may be connected to the second housing **412**. The first spring **416** may restore the position of the second housing **412** relative to the first housing **411** through the restoring force. For example, when the support member **413** moves forward, the pushrod **32** formed in the support member **413** may come into contact with the lever member **415** to rotate the lever member **415**. The lever member **415** may rotate to press the second housing **412** forward, and the first spring **416** may be compressed by the second housing **412**. When the support member **413** moves backward, the contact between the lever member **415** and the pushrod **32** may be released, and thus an external force applied to the first spring **416** may be removed. When the external force is removed, the first spring **416** may restore the position of the second housing **412** connected to the end to its original position, e.g., backward, by the restoring force.

In an embodiment, the second spring **417** may be installed in the second housing **412**. For example, one end of the second spring **417** may be connected to the rear end of the firing pin **43**, and the other end of the second spring **417** may be connected to the first housing **411**. The second spring **417** may be compressed when the second housing **412** is pressed forward. When no external force is applied to the second housing **412**, the second spring **417** may apply a restoring force to the firing pin **43** such that at least a portion of the firing pin **43** is positioned on the first opening **4111**. For example, when the lever member **415** is not in contact with the pushrod **32**, the lever member **415** may not press the second housing **412**, and the second spring **417** may allow at least a portion of the front of the firing pin **43** to be positioned on the first opening **4111**. As the lever member **415** presses the second housing **412** forward, the second housing **412**, the second spring **417**, and the firing pin **43** may move forward, and the front of the firing pin **43** that has passed through the first opening **4111** may contact the rear end of the laser diode primer **42**. When the support member **413** continues moving forward after the front of the firing pin **43** contacts the rear end of the laser diode primer **42**, the second spring **417** may be compressed. That is, the second spring **417** may allow the lever member **415** to press the second housing **412** forward beyond a gap between the front end of the firing pin **43** and the rear end of the laser diode primer **42**.

In an embodiment, the firing pin **43** may be installed inside the second housing **412** such that it may pass through the first opening **4111**. The front end of the firing pin **43** may protrude forward when the second housing **412** is pressed forward. For example, when the second housing **412** is pressed forward, the front end of the firing pin **43** may protrude forward through the second opening **4121** of the second housing **412** and the first opening **4111** of the first housing **411**. In this case, the firing pin **43** may protrude forward to contact the rear end of the laser diode primer **42**, and may transfer an electrical firing signal to the laser diode primer **42** while in contact. In an embodiment, the firing pin **43** may be configured to contact the rear end of the laser diode primer **42** by a rotation of the lever member **415**. For example, while the breechblock **30** is moving from the open position to the closed position, the lever member **415** may rotate to press the second housing **412** forward, and when the second housing **412** is pressed forward, the firing pin **43** may protrude forward to contact the rear end of the laser diode primer **42**.

In an embodiment, the controller (not shown) may generate the electrical firing signal. The breech ring **20**, the breechblock **30**, and the second housing **412** may each have an electrical contact portion formed to receive such an electrical signal. The electrical firing signal generated by the controller may be applied to the ignition device **40** via an electrical contact portion (not shown) formed in the ignition device **40**. The electrical contact portion may provide an electrical connection between the respective corresponding components as the barrel **10** recoils and/or returns and the breechblock **30** is opened and/or closed. For example, when the barrel **10** returns and the breechblock **30** is closed, the controller, an electrical contact portion formed in the breech ring **20**, an electrical contact portion formed in the breechblock **30**, and an electrical contact portion **418** formed in the second housing **412** may contact each other to be electrically connected. The second spring **417** and the firing pin **43** may be formed of an electrically conductive material to transfer the electrical firing signal. For example, when the barrel **10** returns and the breechblock **30** is closed, the firing pin **43** may protrude to contact the rear end of the rear end of the laser diode primer **42**, and thus the controller, the electrical contact portion **418**, the second spring **417**, the firing pin **43**, and the laser diode primer **42** may be electrically connected. Therefore, the electrical firing signal generated by the controller may be transferred to the laser diode primer **42**.

FIGS. **3**A through **3**D are schematic views of the cannon **1** illustrating a process in which the ignition device **40** moves forward with respect to the breechblock **30** while the breechblock **30** is descending, according to an embodiment.

The process in which the firing assembly **41** moves forward while the breechblock **30** is descending will be described below with reference to FIGS. **1** and **3**A through **3**D.

In an embodiment, the breech ring **20** may include the cam plate **22** on which the guiding groove **23** is formed. While the breechblock **30** is descending, the follower **4131** may move along the guiding groove **23** formed on the cam plate **22** of the breechblock **30**. The cam plate **22** may be used for typical primer percussion-type ignition. While the follower **4131** is moving along the path of the guiding groove **23**, the support member **413** connected to the follower **4131** may move forward or backward. In an embodiment, the guiding groove **23** may include a first guiding groove portion **231** and a second guiding groove portion **232**. The first guiding groove portion **231** may extend in a height direction (e.g., a +Y direction). The second guiding groove portion **232** may be connected to a bottom of the first guiding groove portion **231** and may extend by being inclined forward. Although the guiding groove **23** is shown as having the first guiding groove portion **231** and the second guiding groove portion **232** in FIGS. **1** and **3**A through **3**D, it is apparent to a person of ordinary skill in the art that the structure of the guiding groove **23** may be changed suitably to move the ignition device **40** forward. For example, the guiding groove **23** may include a curved guiding groove portion to allow the ignition device **40** to move forward.

When the breechblock **30** is at the open position (refer to FIG. **1**), the shell and the propelling charge may be sequentially loaded into the chamber **11**. When the shell and the

propelling charge are loaded, the breechblock **30** may start descending. While the follower **4131** is moving along the first guiding groove portion **231**, the ignition device **40** may not move forward (refer to FIG. **3**A). While the follower **4131** is moving along the second guiding groove portion **232**, the ignition device **40** may move forward (refer to FIG. **3**B). While the follower **4131** is moving along the second guiding groove portion **232**, the ignition device **40** may move forward, and the lever member **415** may contact the pushrod **32** (refer to FIG. **3**C). While the follower **4131** is moving along the second guiding groove portion **232**, the lever member **415** may rotate by the pushrod **32**, and the firing pin **43** may protrude forward (refer to FIG. **3**D).

As the firing pin **43** protrudes and comes into contact with the laser diode primer **42**, an electrical firing signal may be transferred and, after the shell is fired, the breechblock **30** may be opened. While the breechblock **30** is opening, the ignition device **40** may move backward by a movement of the follower **4131**, and the contact between the firing pin **43** and the laser diode primer **42** may be released.

FIGS. **4**A and **4**B are schematic views of the cannon **1** illustrating the laser diode primer **42** that ignites gunpowder **422** with a laser diode **4232**, according to an embodiment.

Referring to FIG. **4**A, the laser diode primer **42** may receive an electrical firing signal from the firing pin **43**. The laser diode primer **42** may be mounted on the primer holder **44** and may move forward or backward along with the firing assembly **41**. That is, a gap between the laser diode primer **42** and the firing assembly **41** may be maintained constant, and an electrical connection may be applied or released by a forward or backward movement of the firing pin **43**. The laser diode primer **42** may include a case **421**, the gunpowder **422**, and a primer cup **423**.

In an embodiment, the gunpowder **422** and the primer cup **423** may be disposed inside the case **421**. A space may be formed inside the case **421**, in which the gunpowder **422** and the primer cup **423** are disposed. For example, the case **421** may be provided in the form of a hollow cylinder.

In an embodiment, the gunpowder **422** may be disposed inside a container **424** and may generate a flame. A space may be formed in the container **424**, in which the gunpowder **422** is disposed. For example, the container **424** may be provided in the form of a hollow cylinder. One end of the container **424** that faces forward may be closed by a container cup **425**, and the other end of the container **424** that faces backward may contact the primer cup **423**. When the gunpowder **422** is ignited by the primer cup **423**, a flame may be generated, and the generated flame may be transferred toward the front of the cannon **1**. The generated flame may remove the container cup **425**, and the generated flame may be transferred through the primer flame hole **31** to the propelling charge disposed in the chamber **11**. For example, the container **424** may be formed of a material that endures the pressure generated by the gunpowder **422**, and may have an internal structure formed to transfer the generated flame forward.

In an embodiment, the primer cup **423** may be configured to ignite the gunpowder **422**. The primer cup **423** may be disposed inside the case **421** to emit a laser beam toward the gunpowder **422** when activated. For example, the primer cup **423** may be disposed at the rear end of the container **424** in which the gunpowder **422** is disposed. The primer cup **423** may also be disposed to be electrically connected to the firing pin **43** inside the case **421**. That is, it may be disposed to release the contact with the firing pin **43** when the firing pin **43** moves backward, and disposed to contact the firing pin **43** when the firing pin **43** moves forward. The primer cup **423** may include a cup **4231** and the laser diode **4232**.

In an embodiment, the laser diode **4232** may be disposed inside the cup **4231**. At one end of the cup **4231**, a firing pin contact portion **4233** that may selectively contact the firing pin **43** may be formed. The firing pin contact portion **4233** may be formed of an electrically conductive material. For example, as the firing pin **43** moves forward, the front end of the firing pin **43** may come into contact with the firing pin contact portion **4233** formed at the one end of the cup **4231**, and an electrical firing signal may be transferred from the firing pin **43** to the firing pin contact portion **4233**.

In an embodiment, the laser diode **4232** may emit (or oscillate) a laser toward the gunpowder **422**. For example, the laser diode **4232** may be activated when the firing pin contact portion **4233** receives the electrical firing signal. The laser diode **4232** may be fixed inside the cup **4231** through molding to emit the laser toward the gunpowder **422**.

Referring to FIG. **4**B, the laser diode primer **42** may include the case **421**, the gunpowder **422**, the primer cup **423**, a primer ignition material **426**, and a through-hole **427**. In an embodiment, the primer ignition material **426** may be used to ignite the gunpowder **422**. When receiving the laser emitted by the laser diode **4232**, the primer ignition material **426** may be ignited, generating a flame. For example, the primer ignition material **426** may be used when an output power of the laser is not sufficient to ignite the gunpowder **422**. Although not shown in FIG. **4**B, the primer ignition material **426** may be disposed inside a separate container **424**.

In an embodiment, the through-hole **427** may be formed to penetrate between the primer ignition material **426** and the gunpowder **422**. Thus, when the laser generated by the laser diode **4232** ignites the primer ignition material **426**, the generated flame may be transferred to the gunpowder **422** through the through-hole **427**, and a flamed may be generated again to be transferred to the propelling charge through the primer flame hole **31**. The through-hole **427** may be formed of a material that endures the pressure generated by the ignition of the primer ignition material **426**. Although, the through-hole **427** is shown as separate from the container **424** in FIG. **4**B, it may be formed at the rear end of the container **424** to be integral with the container **424**

While this disclosure includes specific examples, it will be apparent after an understanding of the disclosure of this application that various changes in form and details may be made in these examples without departing from the spirit and scope of the claims and their equivalents. The embodiments described herein are to be considered in a descriptive sense only, and not for purposes of limitation. Descriptions of features or aspects in each embodiment are to be considered as being applicable to similar features or aspects in other embodiment. Suitable results may be achieved if the described techniques are performed in a different order, and/or if components in a described system, architecture, device, or circuit are combined in a different manner, and/or replaced or supplemented by other components or their equivalents.

Therefore, in addition to the above disclosure, the scope of the disclosure may also be defined by the claims and their equivalents, and all variations within the scope of the claims and their equivalents are to be construed as being included in the disclosure.

What is claimed is:

1. A cannon, comprising:

a barrel having a chamber formed therein in which a shell and a propelling charge are mounted;

a breech ring connected to the rear of the barrel, and having a shell inlet communicating with the chamber;

a breechblock connected to the breech ring to be movable upward and downward with respect to the breech ring between a closed position that closes the shell inlet and an open position that opens the shell inlet, and having a primer flame hole communicating with the chamber at the closed position;

an ignition device mounted to be partially movable with respect to the breechblock and configured to ignite the propelling charge mounted in the chamber through the primer flame hole; and

a controller configured to transfer an electrical firing signal to the ignition device,

wherein the ignition device comprises:

a firing assembly configured to move forward and backward as the breechblock moves;

a laser diode primer comprising a case and gunpowder disposed inside the case, connected to the front of the firing assembly and contacting the rear of the primer flame hole at the closed position, and configured to receive the electrical firing signal to ignite the propelling charge through the primer flame hole; and

a firing pin connected to the firing assembly to be movable forward and backward with respect to the firing assembly and configured to transfer the electrical firing signal to the laser diode primer while in contact with a rear end of the laser diode primer.

2. The cannon of claim **1**, wherein the firing assembly comprises:

a support member;

a first housing disposed on the support member and comprising a first opening that is open forward;

a second housing disposed within the first housing, movable forward and backward inside the first housing, and comprising a second opening that is open forward; and

a lever member configured to press the second housing forward through a rotation,

wherein the firing pin is installed in the second housing such that a front end thereof passes through the first opening.

3. The cannon of claim **2**, wherein the firing assembly further comprises:

a first spring installed in the first housing and configured to restore a position of the second housing.

4. The cannon of claim **3**, wherein the firing pin is positioned inside the first housing when no external force is applied, and

the front end protrudes to the front of the first housing when the second housing is pressed forward by the lever member.

5. The cannon of claim **4**, wherein the firing pin comes into contact with the rear end of the laser diode primer by a rotation of the lever member when the breechblock is at the closed position.

6. The cannon of claim **5**, wherein the firing assembly further comprises:

a second spring installed in the second housing and connected to a rear end of the firing pin,

wherein the second spring is compressed when the second housing is pressed forward, and applies a restoring force to the firing pin such that at least a portion of the firing pin is positioned on the first opening when no external force is applied to the second housing.

7. The cannon of claim **2**, wherein the breech ring further comprises:

a cam plate having a guiding groove formed therein,

wherein the support member further comprises a follower movably connected to the guiding groove, and

the breechblock further comprises a pushrod selectively contacting the lever member,

wherein, while the breechblock is moving from the open position to the closed position, the firing assembly moves forward by a movement of the follower, and

the lever member rotates by contacting the pushrod by the forward movement of the firing assembly.

8. The cannon of claim **7**, wherein the guiding groove comprises:

a first guiding groove portion extending in a height direction; and

a second guiding groove portion connected to a bottom of the first guiding groove portion and extending downward while inclined forward,

wherein the ignition device moves forward and backward with respect to the breechblock as the follower moves along the second guiding groove portion.

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